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Original Research Article

Prevalence of Liver Function Test Abnormality and Associated Factors in Type 2 Diabetes Mellitus: A Comparative Cross-Sectional Study

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Abstract

Introduction: Type 2 diabetes mellitus (T2DM) is associated with a variety of hepatic abnormalities, ranging from non-alcoholic fatty liver disease (NAFLD) to advanced fibrosis, often reflected by alterations in liver function tests (LFTs). Early detection of such abnormalities is important for comprehensive management and prevention of complications.

Objectives: To determine the prevalence of liver function test abnormalities in patients with T2DM and to identify associated clinical and biochemical factors, compared with non-diabetic controls.

Methods: This comparative cross-sectional study was conducted over a period of one year at Raiganj Government Medical College and Hospital. A total of 100 adult patients diagnosed with type 2 diabetes mellitus attending the outpatient department were enrolled. The study variables included demographic factors such as age, sex distribution (male and female), duration of diabetes, and body mass index (BMI). Laboratory parameters assessed, comprised glycosylated hemoglobin (HbA1c) and liver function tests including alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), bilirubin, and albumin levels. Data were collected through patient interviews, clinical examinations, and biochemical investigations. The aim was to compare liver function parameters and their association with glycemic control and diabetes duration among type 2 diabetic patients.

Results: Liver function test abnormalities are common in patients with type 2 diabetes mellitus, with elevated ALT and AST levels observed in 38% and 34% of patients, respectively. These abnormalities were significantly associated with poor glycemic control and higher BMI. Patients with HbA1c ≥7% had significantly higher ALT and AST levels and lower albumin compared to those with better glycemic control. Additionally, the prevalence of elevated liver enzymes increased progressively with higher BMI categories. Multivariate analysis identified male sex, longer diabetes duration (≥5 years), overweight/obesity (BMI ≥25 kg/m²), and poor glycemic control as independent risk factors for liver dysfunction, with poor glycemic control being the strongest predictor.

Conclusion: LFT abnormalities are common in patients with T2DM and are associated with obesity, longer disease duration, poor glycemic control, and dyslipidemia. Routine monitoring of liver enzymes in T2DM patients may help in early identification and management of underlying hepatic disorders.

Keywords: Type 2 diabetes mellitus, liver function tests, alanine aminotransferase, aspartate aminotransferase, non-alcoholic fatty liver disease, dyslipidemia.

Introduction

Type 2 diabetes mellitus (T2DM) has emerged as a global health challenge, with its metabolic derangements extending well beyond glucose homeostasis to involve multiple organ systems. One such system is the liver, which is frequently affected by metabolic dysfunction-associated steatotic liver disease (MASLD), formerly known as non-alcoholic fatty liver disease (NAFLD) [1].

MASLD has become the most common cause of chronic liver disease in adults, paralleling rising rates of obesity and T2DM globally. Among individuals with T2DM, MASLD prevalence exceeds 60% and may approach nearly universal levels in those with severe obesity. The clinical spectrum spans from simple steatosis to metabolic dysfunction-associated steatohepatitis (MASH),

which increases risks of fibrosis, cirrhosis, and hepatocellular carcinoma [2].

Routine liver function tests (LFTs) — including ALT, AST, ALP, bilirubin, and GGT — are frequently abnormal in patients with T2DM, reflecting underlying hepatic cellular injury or cholestasis [3]. Elevated LFTs may indicate insulin resistance, subclinical steatosis, or progression towards steatohepatitis [4]. Epidemiological studies in diverse populations have reported varying prevalence rates; for instance, in China, elevated ALT and AST were found in 10.3% and 6.1% of T2DM patients, respectively, with male sex, obesity, hypertension, hypertriglyceridemia, and alcohol intake identified as significant associates [5]. In North Indian adults, 62.5% of T2DM subjects exhibited deranged LFTs—significantly higher than in non-diabetic controls—underscoring region-specific epidemiological trends [6].

Further, studies analyzing metabolic syndrome components report elevated liver enzymes in approximately 16%, 9%, and 23% of T2DM patients for ALT, AST, and GGT respectively, with strong links to obesity, dyslipidemia, and poor glycemic control [7]. In Bangladesh, a comparative cross-sectional study revealed that 58% of T2DM patients had at least one LFT abnormality, with ALT elevation, prolonged prothrombin time, and hypoalbuminemia among the common findings [8]. Notably, fatty liver on ultrasound was observed in over half of T2DM participants, consistent with global imaging trends [9].

The presence of MASLD or MASH in T2DM has broader implications than liver-related morbidity alone. Coexisting hepatic steatosis or elevated LFTs contributes to amplified cardiovascular risk and progression to advanced liver disease, including cirrhosis and hepatocellular carcinoma [10]. Given the increasing global burden and underdiagnosis of aggressive fatty liver disease in T2DM—recent estimates suggest that two-thirds of T2DM individuals have MASLD while many remain undiagnosed—there is an urgent need for improved screening and risk stratification. Taken together, the high prevalence of LFT abnormalities in T2DM, their reliable associations with obesity, dyslipidemia, hypertension, and poor glycemic control, and their implications for disease progression and comorbidity underscore the clinical importance. However, comparative studies between diabetic and non-diabetic populations across diverse geographic and clinical settings remain limited.

Materials and Methods

Study Design: Comparative cross-sectional study.

Place of study: Raiganj Govt Medical College and Hospital.

Period of study: 1 year.

Study Variables

- Age
- Male
- Female
- Duration of Diabetes
- BMI
- HbA1c
- LFT Parameter
- ALT
- AST
- ALP
- Bilirubin
- Albumin

Sample size: 100 Adult patients diagnosed with type 2 diabetes mellitus attending the outpatient department.

Inclusion Criteria

- Adults aged 40-60 years
- Diagnosed cases of type 2 diabetes mellitus (per ADA criteria).
- Age- and sex-matched non-diabetic controls for comparison.
- Willingness to provide informed consent.

Exclusion Criteria

- History of chronic liver disease (viral hepatitis, autoimmune hepatitis, cirrhosis).
- Significant alcohol consumption (>20 g/day for women, >30 g/day for men).
- Current use of hepatotoxic drugs.
- Pregnancy or lactation.
- Acute illness or infection at the time of study.
- Unwillingness to participate.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software, Continuous variables were expressed as mean ± standard deviation (SD) and compared between groups using the independent samples t-test for normally distributed data or the Mann–Whitney U test for non-normally distributed data. Categorical variables were expressed as frequencies and percentages, and associations between groups were assessed using the Chi-square test or Fisher's exact test, as appropriate. Logistic regression analysis was performed to identify independent predictors of liver function test abnormalities among type 2 diabetes mellitus patients. A p-value < 0.05 was considered statistically significant.

Result

Table 1: Baseline Characteristics of the Study Population (n = 100)

Variable	Mean ± SD / n (%)
Age (years)	54.6 ± 8.9
Male	58 (58.0%)
Female	42 (42.0%)
Duration of Diabetes (years)	7.8 ± 4.2
BMI (kg/m²)	27.3 ± 3.8
HbA1c (%)	8.2 ± 1.4

Table 2: Prevalence of Liver Function Test (LFT) Abnormalities

LFT Parameter	Abnormal n (%)	Normal n (%)	p-value
ALT (>40 U/L)	38 (38.0%)	62 (62.0%)	0.002
AST (>40 U/L)	34 (34.0%)	66 (66.0%)	0.005
ALP (>120 U/L)	22 (22.0%)	78 (78.0%)	0.041
Total Bilirubin (>1.2)	8 (8.0%)	92 (92.0%)	0.311
Albumin (<3.5 g/dL)	12 (12.0%)	88 (88.0%)	0.152

Table 3: Comparison of Mean LFT Values between Type 2 Diabetes Patients with and without Poor Glycemic Control (HbA1c ≥7%)

Parameter	HbA1c < 7% (n = 32) Mean ± SD	HbA1c ≥ 7% (n = 68) Mean ± SD	p-value
ALT (U/L)	32.4 ± 9.8	45.7 ± 15.2	0.001
AST (U/L)	30.2 ± 8.5	41.6 ± 13.9	0.002
ALP (U/L)	105.3 ± 20.6	112.8 ± 25.4	0.118
Bilirubin (mg/dL)	0.78 ± 0.21	0.81 ± 0.25	0.543
Albumin (g/dL)	4.1 ± 0.4	3.8 ± 0.5	0.029

Table 4: Association between BMI and LFT Abnormalities

BMI Category (kg/m²)	ALT Abnormal (%)	AST Abnormal (%)	p-value (ALT)	p-value (AST)
Normal (<25)	9 (23.1%)	7 (17.9%)	0.011	0.018
Overweight (25–29.9)	17 (40.5%)	16 (38.1%)		
Obese (≥30)	12 (60.0%)	11 (55.0%)		

Table 5: Multivariate Logistic Regression for Predictors of LFT Abnormality

Variable	Adjusted OR	95% CI	p-value
Male sex	1.82	1.04 – 3.21	0.037
Duration of DM ≥ 5 years	2.45	1.28 – 4.67	0.006
BMI ≥ 25 kg/m²	2.72	1.49 – 4.95	0.001
Poor glycemic control	3.14	1.68 – 5.86	<0.001

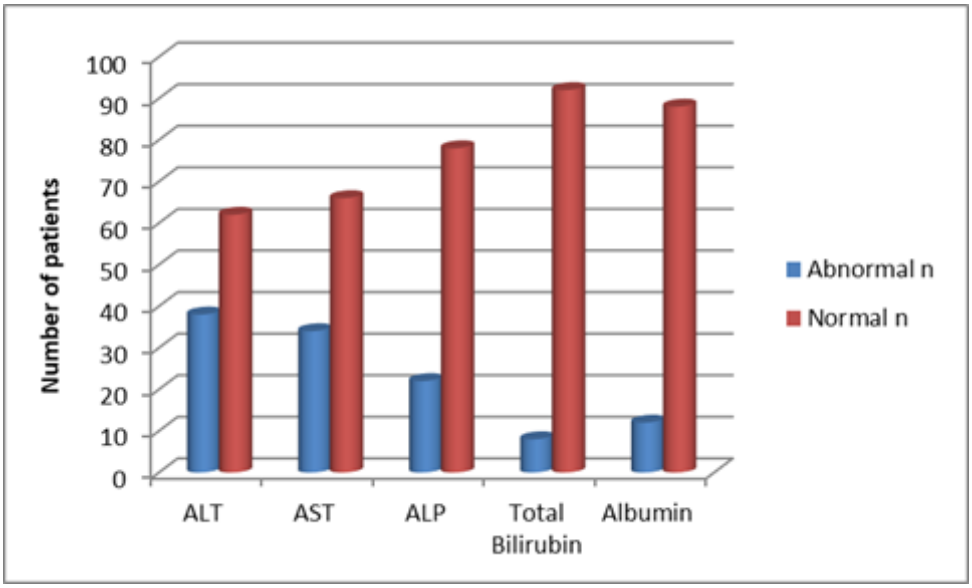

Figure 1: Prevalence of Liver Function Test (LFT) Abnormalities

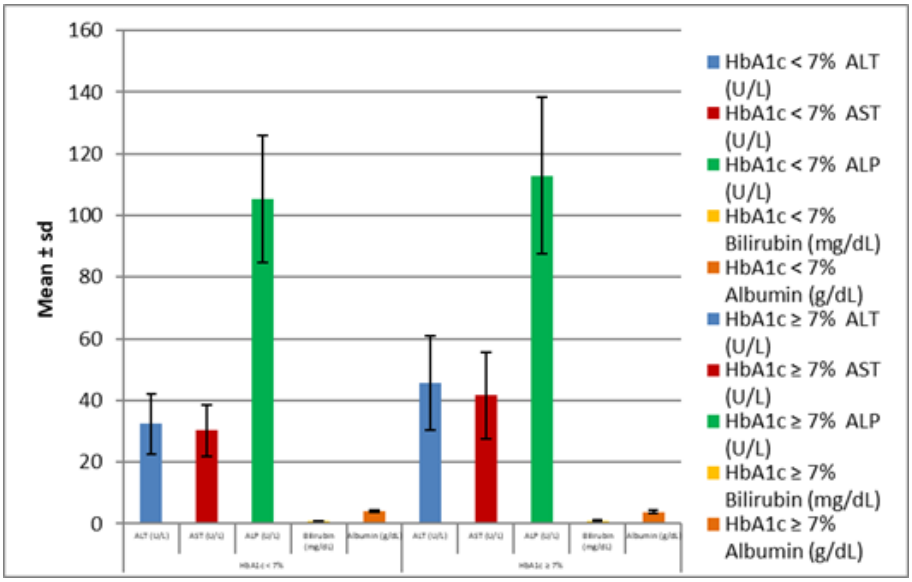

Figure 2: Comparison of Mean LFT Values between Type 2 Diabetes Patients with and without Poor Glycemic Control (HbA1c ≥7%)

In our study, the mean age of the participants was 54.6 ± 8.9 years. There was a slight male predominance, with 58 (58.0%) males and 42 (42.0%) females. The average duration of diabetes among the patients was 7.8 ± 4.2 years. The mean body mass index (BMI) was 27.3 ± 3.8 kg/m², a substantial proportion of the study population was overweight. The mean glycated hemoglobin (HbA1c) level was 8.2 ± 1.4%, suggesting that, on average, patients had suboptimal glycemic control.

In the present study, elevated alanine aminotransferase (ALT) levels (>40 U/L) were observed in 38 patients (38.0%), which was statistically significant (p = 0.002). Aspartate aminotransferase (AST) elevation (>40 U/L) was noted in 34 patients (34.0%) with a significant association (p = 0.005). Alkaline phosphatase (ALP) elevation (>120 U/L) was found in 22 patients (22.0%) and was also statistically significant (p = 0.041). In contrast, total bilirubin levels above 1.2 mg/dL were seen in only 8 patients (8.0%), and hypoalbuminemia (<3.5 g/dL) in 12 patients (12.0%), neither of which showed statistical significance (p = 0.311 and p = 0.152, respectively).

When comparing liver function parameters between patients with good glycemic control (HbA1c < 7%) and those with poor glycemic control (HbA1c ≥ 7%), significantly higher mean ALT (45.7 ± 15.2 U/L vs. 32.4 ± 9.8 U/L, p = 0.001) and AST (41.6 ± 13.9 U/L vs. 30.2 ± 8.5 U/L, p = 0.002) levels were observed in the poor control group. Mean ALP levels were slightly higher in the poor control group (112.8 ± 25.4 U/L vs. 105.3 ± 20.6 U/L), but this difference was not statistically significant (p = 0.118). Mean total bilirubin values were comparable between groups (0.81 ± 0.25 mg/dL vs. 0.78 ± 0.21 mg/dL, p = 0.543). Albumin levels were significantly lower in patients with poor glycemic control compared to those with good control (3.8 ± 0.5 g/dL vs. 4.1 ± 0.4 g/dL, p = 0.029).

The prevalence of abnormal ALT and AST levels showed a significant association with BMI categories. Among patients with a normal BMI (<25 kg/m²), 23.1% had elevated ALT and 17.9% had elevated AST levels. This prevalence increased in the overweight group (25–29.9 kg/m²), with 40.5% showing ALT abnormalities and 38.1% showing AST abnormalities. The highest prevalence was observed in the obese group (≥30 kg/m²), where 60.0% had abnormal ALT and 55.0% had abnormal AST levels. The differences in ALT and AST abnormalities across BMI categories were statistically significant, with p-values of 0.011 and 0.018, respectively.

Multivariate logistic regression analysis identified several independent predictors of liver function test abnormalities in patients with type 2 diabetes mellitus. Male sex was associated with a 1.82-fold increased risk of LFT abnormalities (adjusted OR: 1.82; 95% CI: 1.04–3.21; p = 0.037). A duration of diabetes of 5 years or more significantly increased the odds by 2.45 times (adjusted OR: 2.45; 95% CI: 1.28–4.67; p = 0.006). Patients with a BMI ≥ 25 kg/m² had a 2.72-fold higher risk of abnormal liver function (adjusted OR: 2.72; 95% CI: 1.49–4.95; p = 0.001). Poor glycemic control emerged as the strongest predictor, with a more than threefold increased risk (adjusted OR: 3.14; 95% CI: 1.68–5.86; p < 0.001).

Discussion

The present study shows a substantial prevalence of liver function test (LFT) abnormalities among

patients with type 2 diabetes mellitus (T2DM), consistent with findings from previous research. The overall prevalence of elevated ALT (38.0%) and AST (34.0%) in our cohort is comparable to the ranges reported by Farahat et al. [1] and Zhang et al. [2], who observed elevated transaminases in 30–45% of diabetic populations. The significant association of abnormal ALT and AST levels with poor glycemic control in our study reinforces the concept that hyperglycemia contributes to hepatic injury, likely through mechanisms such as insulin resistance and oxidative stress [3,4]. Similar findings were reported by Al-Daydamony and El-Sayed [5], who found that higher HbA1c levels were strongly correlated with increased liver enzymes. The impact of BMI on liver abnormalities was evident, with obese patients showing the highest prevalence of ALT and AST elevation, supporting the well-established link between obesity, nonalcoholic fatty liver disease (NAFLD), and liver enzyme elevation in T2DM [6,7]. This association was also confirmed by Singh et al. [8] and Kheirandish-Gozal et al. [9], emphasizing the importance of weight management in diabetic patients to mitigate hepatic complications. Our logistic regression analysis identified male sex, longer diabetes duration, overweight/obesity, and poor glycemic control as independent predictors of LFT abnormalities.

These findings align with those of Targher et al. [10], who documented similar risk factors for NAFLD in diabetes. The stronger predictive value of poor glycemic control observed in our study underlines the need for stringent metabolic management to prevent progressive liver damage in this population. In conclusion, the study adds to the growing body of evidence that liver dysfunction is a common comorbidity in T2DM and is strongly influenced by modifiable factors such as glycemic control and BMI. Early detection and intervention are crucial to improving patient outcomes and preventing long-term hepatic complications.

Conclusion

In conclusion, this study demonstrates a high prevalence of liver function test abnormalities among patients with type 2 diabetes mellitus, with elevated ALT and AST levels being the most common findings. Poor glycemic control, increased BMI, longer duration of diabetes, and male sex were identified as significant independent predictors of liver dysfunction.

These findings underscore the importance of regular monitoring of liver enzymes in diabetic patients, especially those with uncontrolled blood sugar levels and higher body weight. Early detection and management of liver abnormalities can help prevent progression to more severe hepatic complications such as nonalcoholic fatty liver disease and cirrhosis. Therefore, integrated care focusing on optimal glycemic control and weight management should be prioritized to improve overall liver health and reduce morbidity in this population.

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